

## WHAT IS CLAIMED IS:

- 1 1. A picture composing apparatus comprising:
  - 2 a plurality of image pickup means;
  - 3 image pickup situation detecting means for detecting
  - 4 an image pickup situation of said image pickup means;
  - 5 first projecting means for projecting a plurality of
  - 6 images taken by said image pickup means onto a projection
  - 7 section in accordance with the image pickup situation
  - 8 detected by said image pickup situation detecting means to
  - 9 generate a plurality of first projected images;
  - 10 second projecting means for projecting said plurality of
  - 11 first projected images to a three-dimensional projection
  - 12 model to generate a second projected image;
  - 13 virtual image pickup means for virtually picking up
  - 14 said second projected image;
  - 15 three-dimensional projection model determining means
  - 16 for determining a position of said three-dimensional
  - 17 projection model and a shape thereof; and
  - 18 pickup situation determining means for determining an
  - 19 image pickup situation of said virtual image pickup means,
  - 20 said second projected image being picked up by said
  - 21 virtual image pickup means in the image pickup situation
  - 22 determined by said pickup situation determining means to

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23 combine the plurality of images taken by said plurality of  
24 image pickup means.

1 2. The picture composing apparatus according to claim 1,  
2 wherein said image pickup situation detecting means  
3 previously detects at least one of a position, posture and  
4 image pickup characteristic of said image pickup means with  
5 respect to said projection section.

1 3. The picture composing apparatus according to claim 1,  
2 wherein said first projecting means projects points on the  
3 images taken by said image pickup means to said projection  
4 section through the use of a transformation matrix obtained  
5 by associating a plurality of points on the taken images with  
6 a plurality of points on said projection section.

1 4. The picture composing apparatus according to claim 1,  
2 wherein said projection section is substantially a plane.

1 5. The picture composing apparatus according to claim 1,  
2 wherein said three-dimensional projection model is a  
3 spherical surface.

1 6. The picture composing apparatus according to claim 1,  
2 wherein said three-dimensional projection model is a  
3 combination of a plurality of surfaces different in shape from  
4 each other.

1 7. The picture composing apparatus according to claim 6,  
2 wherein said three-dimensional projection model is a  
3 combination of a plane and a cylinder, and when said second  
4 projecting means conducts the projection to said three-  
5 dimensional projection model, a distant place is projected to  
6 said cylinder and the other place is projected to said plane  
7 and said virtual image pickup means picks up the projected  
8 image .

1 8. The picture composing apparatus according to claim 6,  
2 wherein said plurality of surfaces different in shape are  
3 combined so that a joint therebetween does not stand out.

1 9. The picture composing apparatus according to claim 6,  
2 wherein said three-dimensional projection model is a  
3 combination of a sphere and a cylinder, and when said second  
4 projecting means conducts the projection to said three-  
5 dimensional projection model, a distant place is projected to

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6 said cylinder and the other place is projected to said sphere  
7 and said virtual image pickup means picks up the projected  
8 image.

1 10. The picture composing apparatus according to claim 8,  
2 wherein said three-dimensional projection model is a  
3 combination of three types of surfaces of a cylinder, a plane  
4 and a curved surface establishing smooth boundary between  
5 said cylinder and said plane.

1 11. The picture composing apparatus according to claim 1,  
2 wherein a line segment on the image taken by said image  
3 pickup means is converted into a straight line on a composite  
4 picture.

1 12. The picture composing apparatus according to claim 1,  
2 wherein said plurality of image pickup means are mounted  
3 on a motor vehicle, and motor vehicle running direction  
4 detecting means is further provided to detect a running  
5 direction of said motor vehicle.

1 13. The picture composing apparatus according to claim 12,  
2 wherein a position of a viewing point of said virtual image

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3 pickup means is set on a straight line passing through a  
4 projection center of said second projecting means in parallel  
5 with the running direction of said motor vehicle.

1 14. The picture composing apparatus according to claim 12,  
2 wherein a line segment representative of the running  
3 direction of said motor vehicle is converted into a straight  
4 line on a composite picture.

1 15. The picture composing apparatus according to claim 1,  
2 wherein said plurality of image pickup means are mounted  
3 on a motor vehicle, and motor vehicle body position detecting  
4 means is further provided to detect a body position of said  
5 motor vehicle.

1 16. The picture composing apparatus according to claim 15,  
2 wherein a position of a viewing point of said virtual image  
3 pickup means is set on a plane passing through an image  
4 obtained by plane-projecting an end portion of said body of  
5 said motor vehicle and a projection center of said second  
6 projecting means.

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1 17. The picture composing apparatus according to claim 11,  
2 wherein said image pickup means is mounted on a rear end  
3 portion of a motor vehicle, and rear end portion of said motor  
4 vehicle is converted into a straight line on a composite  
5 picture.

1 18. The picture composing apparatus according to claim 11,  
2 wherein said image pickup means is mounted on a side  
3 portion of a motor vehicle, and said side portion of said motor  
4 vehicle is converted into a straight line on a composite  
5 picture.

1 19. The picture composing apparatus according to claim 11,  
2 wherein said image pickup means is mounted on a side  
3 portion of a motor vehicle, and a center line of a lane adjacent  
4 to a lane said motor vehicle is running on is converted into a  
5 straight line on a composite picture.

1 20. The picture composing apparatus according to claim 11,  
2 wherein said image pickup means is mounted on a rear  
3 portion of a motor vehicle, and a center line of a road  
4 perpendicular to a road said motor vehicle is running on is  
5 converted into a straight line on a composite picture.

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1 21. The picture composing apparatus according to claim 11,  
2 wherein said image pickup means is mounted on a front  
3 portion of a motor vehicle, and a center line of a road  
4 perpendicular to a road said motor vehicle is running on is  
5 converted into a straight line on a composite picture.

1 22. A picture composing apparatus comprising:  
2 a plurality of image pickup means;  
3 image pickup situation detecting means for detecting  
4 an image pickup situation of said image pickup means;  
5 first projecting means for projecting a plurality of  
6 images taken by said image pickup means onto a projection  
7 surface in accordance with the image pickup situation  
8 detected by said image pickup situation detecting means to  
9 generate a plurality of first projected images;  
10 second projecting means for projecting the plurality of  
11 first projected images to a spherical surface to generate a  
12 second projected image; and  
13 converting means for spreading the second projected  
14 image on a plane round one point on said spherical surface.

1 23. A picture composing method comprising:

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2 an image pickup step of picking up a plurality of  
3 images;

4 an image pickup situation detecting step of detecting an  
5 image pickup situation in said image pickup step;

6 a first projecting step of projecting a plurality of images  
7 picked up to a projection section in accordance with the image  
8 pickup situation detected in said image pickup situation  
9 detecting step to generate a plurality of first projected  
10 images;

11 a second projecting step of projecting the plurality of  
12 first projected images to a three-dimensional projection  
13 model to generate a second projected image;

14 a virtual image pickup step of virtually picking up the  
15 second projected image;

16 a three-dimensional projection model determining step  
17 of determining a position of said three-dimensional projection  
18 model and a shape thereof; and

19 an image pickup situation determining step of  
20 determining the image pickup situation in said virtual image  
21 pickup step,

22 the second projected image being picked up in said  
23 virtual image pickup step in the projection situation  
24 determined in said image pickup situation determining step

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25 to combine the plurality of images taken in said image pickup  
26 step.

1 24. A picture composing method according to claim 23,  
2 further comprising a step of sending signal information from  
3 motor vehicle running direction detecting means, which  
4 detects a running direction of a motor vehicle, to image  
5 pickup situation determining means used for said image  
6 pickup situation determining step.

1 25. A picture composing method according to claim 23,  
2 further comprising a step of sending signal information from  
3 motor vehicle body position detecting means, which detects a  
4 body position of a motor vehicle, to image pickup situation  
5 determining means used for said image pickup situation  
6 determining step.

1 26. A picture composing method comprising:  
2 an image pickup step of picking up a plurality of  
3 images;  
4 an image pickup situation detecting step of detecting an  
5 image pickup situation in said image pickup step;

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6 a first projecting step of projecting a plurality of images,  
7 picked up in said image pickup step, to a projection section in  
8 accordance with the image pickup situation detected in the  
9 image pickup situation detecting step, to generate a plurality  
10 of first projected images;

11 a second projecting step of projecting the plurality of  
12 first projected images to a spherical surface to generate a  
13 second projected image;

14 a plane spreading step of spreading the second  
15 projected image on a plane round one point on said spherical  
16 surface; and

17 a spherical surface position determining step of  
18 determining a position of said spherical surface,

19 a plurality of images obtained in said plane spreading  
20 step are combined to produce a composite picture.

1 27. A picture displaying apparatus comprising:

2 a plurality of image pickup means;

3 image pickup situation detecting means for detecting  
4 an image pickup situation of said image pickup means;

5 first projecting means for projecting a plurality of  
6 images taken by said image pickup means onto a projection  
7 section in accordance with the image pickup situation

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8 detected by said image pickup situation detecting means to  
9 generate a plurality of first projected images;  
10 second projecting means for projecting the plurality of  
11 first projected images to a three-dimensional projection  
12 model to generate a second projected image;  
13 virtual image pickup means for virtually picking up the  
14 second projected image;  
15 three-dimensional projection model determining means  
16 for determining a position of said three-dimensional  
17 projection model and a shape thereof;  
18 image pickup situation determining means for  
19 determining an image pickup situation of said virtual image  
20 pickup means;  
21 display means for displaying a picture; and  
22 display data conversion control means for converting a  
23 picture to be displayed into data adaptable to said display  
24 means,  
25 the second projected image being picked up by said  
26 virtual image pickup means in the image pickup situation  
27 determined by said image pickup situation determining  
28 means to combine the plurality of images taken by said  
29 plurality of image pickup means to produce a composite  
30 picture and said composite picture being converted by said

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31 display data conversion control means into data adaptable to  
32 said display means.

1 28. A picture acquiring/warning apparatus comprising:  
2 a plurality of image pickup means;  
3 image pickup situation detecting means for detecting  
4 an image pickup situation of said image pickup means;  
5 first projecting means for projecting a plurality of  
6 images taken by said image pickup means onto a projection  
7 section in accordance with the image pickup situation  
8 detected by said image pickup situation detecting means to  
9 generate a plurality of first projected images;  
10 second projecting means for projecting the plurality of  
11 first projected images to a three-dimensional projection  
12 model to generate a second projected image;  
13 virtual image pickup means for virtually picking up the  
14 second projected image;  
15 three-dimensional projection model determining means  
16 for determining a position of said three-dimensional  
17 projection model and a shape thereof;  
18 image pickup situation determining means for  
19 determining an image pickup situation of said virtual image  
20 pickup means;

21 detecting means for detecting an approaching situation  
22 of an object; and  
23 warning means for issuing arbitrary warning  
24 information when the object approaching situation detected  
25 by said detecting means reaches a predetermined object  
26 approaching situation.

1 29. A motor vehicle position recognition/decision apparatus  
2 comprising:  
3 a plurality of image pickup means mounted on a motor  
4 vehicle;  
5 image pickup situation detecting means for detecting  
6 an image pickup situation of said image pickup means;  
7 first projecting means for projecting a plurality of  
8 images taken by said image pickup means onto a projection  
9 section in accordance with the image pickup situation  
10 detected by said image pickup situation detecting means to  
11 generate a plurality of first projected images;  
12 second projecting means for projecting the plurality of  
13 first projected images to a three-dimensional projection  
14 model to generate a second projected image;  
15 virtual image pickup means for virtually picking up the  
16 second projected image;

17 three-dimensional projection model determining means  
18 for determining a position of said three-dimensional  
19 projection model and a shape thereof;

20 image pickup situation determining means for  
21 determining an image pickup situation of said virtual image  
22 pickup means;

23 image detecting means for, when at least one of said  
24 plurality of image pickup means is backward image pickup  
25 means placed on a rear side of said motor vehicle, detecting  
26 an image of an arbitrary object from images taken by said  
27 backward image pickup means, images obtained by  
28 projecting the taken image to said three-dimensional  
29 projection mode or a picture obtained by combining the taken  
30 images in said virtual image pickup means;

31 recognizing means for recognizing a positional  
32 relationship between the image detected by said image  
33 detecting means and an image of said motor vehicle; and

34 decision means for making a decision on a positional  
35 difference between said motor vehicle and said object on the  
36 basis of the positional relationship recognized by said  
37 recognizing means.

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